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EXAMINER
MARKHAM, WESLEY D

ART UNIT	PAPER NUMBER
1762	22

DATE MAILED: 06/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/501,114	TZENG, YONHUA	
	Examiner	Art Unit	
	Wesley D Markham	1762	

-- The MAILING DATE of this communication appears on th cover she t with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 April 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5-19 and 21-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,5-19 and 21-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application as paper #20 on 4/7/2003 after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office Action (i.e., the final Office Action, paper #16, mailed on 12/24/2002) has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/7/2003 has been entered.

Response to Amendment

2. Acknowledgement is made of applicant's amendment E, filed as paper #21 on 4/7/2003, in which Claims 1, 13, 21, 22, 25, and 26 were amended, and Claims 29 – 31 were added. Claims 1, 3, 5 – 19, and 21 – 31 are currently pending in U.S. Application Serial No. 09/501,114, and an Office Action on the merits follows.

Drawings

3. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed. Please note that the drawings filed on 2/10/2000 are objected to by the Draftsperson under 37 CFR 1.84 for the reasons indicated on the attached copy of the PTO-948 form.

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

Correction of Informalities -- 37 CFR 1.85

New corrected drawings must be filed with the changes incorporated therein. Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin. If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings **MUST** be filed within the **THREE MONTH** shortened statutory period set for reply in the "Notice of Allowability." Extensions of time may NOT be obtained under the provisions of 37 CFR 1.136 for filing the corrected drawings after the mailing of a Notice of Allowability. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

Corrections other than Informalities Noted by Draftsperson on form PTO-948.

All changes to the drawings, other than informalities noted by the Draftsperson, **MUST** be made in the same manner as above except that, normally, a highlighted (preferably red ink) sketch of the changes to be incorporated into the new drawings **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made, other than correction of informalities, unless the examiner has approved the proposed changes.

Timing of Corrections

Applicant is required to submit acceptable corrected drawings within the time period set in the Office action. See 37 CFR 1.185(a). Failure to take corrective action within the set (or extended) period will result in **ABANDONMENT** of the application.

Claim Objections

4. Claims 6 and 18 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Specifically, Claim 6 (which depends from Claim 1) requires a pressure between about 1 mtorr and 250 torr, while amended Claim 1 requires a pressure from about 20 to 80 torr (i.e., a narrower range than that claimed in Claim 6). As such, Claim 6 does not further limit Claim 1. Claim 18 (which depends from Claim 13) requires a pressure between 1 mtorr and 250 torr, while amended Claim 13 requires a pressure from about 20 to 80 torr (i.e., a narrower range than that claimed in Claim 18). As such, Claim 18 does not further limit Claim 13.

Claim Observations

5. Please note that the examiner has reasonably interpreted the step of "promoting diamond growth" recited in dependent Claims 26 and 30 to refer to the step of "producing diamond crystals or diamond films" in independent Claim 25, from which Claims 26 and 30 depend.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

7. Claims 1, 3, 5 – 19, and 21 – 31 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to

reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

8. Regarding independent Claim 1 (from which Claims 3, 5 – 12, and 19 depend), the claim was amended to require that (1) the liquid precursor be introduced into an inlet of the reaction chamber in the absence of a gas stream, (2) the vaporized precursor be subjected to a plasma in the absence of a carrier gas, and (3) the pressure range be 20 to 80 Torr. While the applicant's specification as originally filed discloses that the process "does not require the use of compressed gases" (page 5, lines 10 – 12) and can be carried out at a pressure of 1mTorr – 250 Torr (page 14, "Deposition parameters" section), specifically at a pressure of 80 Torr (Examples 1 and 2), 16 Torr (Example 4), or 29 Torr (Example 6), the specification as originally filed does not have support for the three aforementioned limitations. Therefore, independent Claim 1 and the claims that depend from it contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

9. Regarding independent Claim 13 (from which Claims 14 – 18 depend), the claim was amended to require that (1) the liquid precursor be introduced into an inlet of the apparatus in the absence of a gas stream, (2) the diamond crystals or diamond film be produced on the surface of a substrate in the absence of a carrier gas, and (3) the pressure range be 20 to 80 Torr. While the applicant's specification as originally filed discloses that the process "does not require the use of compressed gases"

(page 5, lines 10 – 12) and can be carried out at a pressure of 1mTorr – 250 Torr (page 14, "Deposition parameters" section), specifically at a pressure of 80 Torr (Examples 1 and 2), 16 Torr (Example 4), or 29 Torr (Example 6), the specification as originally filed does not have support for the three aforementioned limitations. Therefore, independent Claim 13 and the claims that depend from it contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

10. Regarding independent Claim 21 (from which Claims 22 – 24 and 29 depend), the claim was amended to require that (1) the reaction chamber be in a "non-magnetic microwave field plasma system", (2) the diamond growth is promoted in the absence of a carrier gas, and (3) the pressure range be 20 to 80 Torr. While the applicant's specification as originally filed discloses that the process "does not require the use of compressed gases" (page 5, lines 10 – 12) and can be carried out at a pressure of 1mTorr – 250 Torr (page 14, "Deposition parameters" section), specifically at a pressure of 80 Torr (Examples 1 and 2), 16 Torr (Example 4), or 29 Torr (Example 6), the specification as originally filed does not have support for the three aforementioned limitations. For example, no disclosure is made in the specification as originally filed that a magnetic field is not utilized in the applicant's diamond deposition process. Therefore, independent Claim 21 and the claims that depend from it contain subject matter which was not described in the specification in such a

way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

11. Regarding independent Claim 25 (from which Claims 26 – 28 and 30 depend), the claim was amended to require that (1) the plasma apparatus be a "non-magnetic microwave field plasma apparatus", (2) the diamond crystals or diamond films be produced on the surface of a substrate in the absence of a carrier gas, and (3) the pressure range be 20 – 80 Torr. While the applicant's specification as originally filed discloses that the process "does not require the use of compressed gases" (page 5, lines 10 – 12) and can be carried out at a pressure of 1mTorr – 250 Torr (page 14, "Deposition parameters" section), specifically at a pressure of 80 Torr (Examples 1 and 2), 16 Torr (Example 4), or 29 Torr (Example 6), the specification as originally filed does not have support for the three aforementioned limitations. For example, no disclosure is made in the specification as originally filed that a magnetic field is not utilized in the applicant's diamond deposition process. Therefore, independent Claim 25 and the claims that depend from it contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

12. Regarding newly added independent Claim 31, the claim requires that (1) the reaction chamber be in a "non-magnetic microwave field plasma system", (2) the microwave power be in the range from about 0.9 kW to 2 kW, (3) the substrate temperature be in the range between about 750°C and 1030°C, and (4) the pressure

range be 20 to 80 Torr. While the applicant's specification as originally filed has support for a microwave power in the range of 600 – 3000 W (page 14, "Deposition parameters" section), specifically 2 kW (Examples 1 – 3), 1.1 kW (Examples 5 and 6), or 1 kW (Example 7); a substrate temperature in the range of 300°C to 1600°C (page 14, "Deposition parameters" section), specifically 1030°C (Example 3) or 754°C (Example 7); and a pressure of 1mTorr – 250 Torr (page 14, "Deposition parameters" section), specifically 80 Torr (Examples 1 and 2), 16 Torr (Example 4), or 29 Torr (Example 6), the specification as originally filed does not have support for the four aforementioned limitations. For example, no disclosure is made in the specification as originally filed that a magnetic field is not utilized in the applicant's diamond deposition process. Additionally, while the applicant's specification originally disclosed a series of broad ranges (i.e., for temperature, power, pressure, etc.) and specific points within the broad ranges (see Examples 1 – 7), the narrower ranges now claimed have endpoints that were not originally disclosed by the applicant. Therefore, independent Claim 31 contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

13. Regarding the limitation that the carrier gas (i.e., the gas that is absent from the process) be hydrogen (H_2) as required by amended Claims 19, 23, and 27, the applicant's specification as originally filed does not have support for this limitation. Specifically, no disclosure is made of hydrogen being absent from the applicant's

claimed process in the specification as originally filed, and therefore Claims 19, 23, and 27 contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

14. Regarding the limitations that (1) the diamond growth rate is between about 2.1 and 2.7 micrometers per hour, (2) the pressure is in the range of about 30 to 36 Torr, and (3) the substrate temperature is in the range of about 720°C to 800°C in newly added Claims 29 and 30, the applicant's specification as originally filed does not have support for these aforementioned three limitations. The applicant's specification originally disclosed diamond growth rates of 0.05 – 20 micrometers per hour (page 7, lines 2 – 4), specifically 2 micrometers per hour (Examples 2 and 5) or 2.7 micrometers per hour (Example 7); a pressure range of about 1 mTorr – 250 Torr (page 14, "Deposition parameters" section), specifically 29 Torr (Example 6) or 36 Torr (Example 7); and a substrate temperature in the range of 300°C to 1600°C (page 14, "Deposition parameters" section), specifically 724°C (Example 5) or 800°C (Example 6). In other words, while the applicant's specification originally disclosed a series of broad ranges (i.e., for temperature, diamond growth rate, pressure, etc.) and specific points within the broad ranges (see Examples 1 – 7), the narrower ranges now claimed have endpoints that were not originally disclosed by the applicant. Therefore, Claims 29 and 30 contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in

the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

16. Claims 1, 3, 5 – 7, 9 – 19, and 21 – 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Semiconductor Energy Lab (JP 05-097583 A), referred to hereinafter as SEL, in view of Pryor (USPN 5,236,545) and either Versteeg et al. (USPN 5,451,260) or Robson et al. (USPN 5,874,014).

17. Regarding independent Claims 1 and 21, SEL teaches a method for forming diamond crystals or a diamond film (Abstract), the method comprising disposing a substrate "4" in a reaction chamber (paragraph [0011] and Figures 1 and 3), introducing, in the absence of a gas stream, a precursor containing methanol or ethanol (i.e., a carbon and oxygen containing compound having a carbon to oxygen ratio greater than one) into an inlet of the reaction chamber (Figures 1 and 3, Abstract, and paragraphs [0010] – [0012]), vaporizing the liquid precursor (paragraph [0012]), and subjecting the vaporized precursor, in the absence of a carrier gas, to a plasma under conditions effective to excite the precursor and

promote diamond growth on the substrate (paragraphs [0010] – [0020]). Further, the liquid precursor taught by SEL is 100% alcohol (paragraph [0010]), and none of the examples of diamond deposition taught by SEL include any water in the liquid precursor material (paragraphs [0013] – [0020]). As such, the liquid precursor of SEL is substantially free of water. In addition, although SEL uses the term "excited" as opposed to "disassociated" to refer to the vaporized precursor material (paragraph [0011]), a microwave-based plasma is formed (paragraph [0011]) and therefore the vaporized precursor material is inherently disassociated (i.e., because a plasma inherently contains disassociated material species). SEL does not explicitly teach that the liquid precursor contains methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one. Specifically, SEL teaches liquid precursors such as methanol and ethanol (Abstract and paragraph [0011]) and that the diamond can be deposited "with 100% of alcohols" (paragraph [0010]), but does not explicitly teach using a combination of methanol and another compound having a carbon to oxygen ratio greater than one as the liquid precursor. Pryor teaches that, in the art of depositing diamond films by a microwave plasma CVD process (i.e., a process analogous to that of SEL), carbon-containing precursors such as methanol or ethanol can be utilized, as well as mixtures thereof (Col.9, lines 3 – 20). In other words, Pryor teaches the functional equivalence of individual methanol and ethanol precursors (e.g., as suggested by SEL) and combined methanol / ethanol precursors for depositing diamond in a plasma enhanced CVD process. Therefore, it would have been

obvious to one of ordinary skill in the art to utilize a mixed methanol / ethanol liquid precursor mixture in the process of SEL with the reasonable expectation of success and obtaining similar results (i.e., successfully depositing a diamond film on a substrate by using liquid alcohol-based precursors without a carrier gas, specifically hydrogen, as desired by SEL) when compared to utilizing either methanol or ethanol precursors individually. In addition, SEL does not explicitly teach that the alcohol-based liquid precursor is a liquid when introduced into the inlet of the reaction chamber. Specifically, SEL teaches that vapor of the liquid precursor is introduced into the reaction chamber (paragraphs [0011] and [0012]). Versteeg et al. teach a liquid delivery system and method for the CVD of films in a reaction chamber (Abstract). Versteeg et al. also teach that any liquid organic precursor solution can be used in their liquid delivery system (Col.2, lines 14 – 15) and that a wide variety of films can be deposited (Col.5, lines 50 – 56). The liquid delivery system can be utilized in a microwave plasma enhanced deposition processes (i.e., a process analogous to that of SEL and Pryor) (Col.2, lines 66 – 68, and Col.3, lines 1 – 2). In this system, a mist of the liquid precursor is introduced into an inlet of the reaction chamber, after which the liquid precursor is vaporized and comes into contact with a substrate to deposit a film (Col.2, lines 3 – 13 and 44 – 68, and Col.3, lines 1 – 14). Versteeg et al. teach that this method of precursor delivery is extremely simple and economical, and it avoids the need for cumbersome mass flow controllers, carrier gases, and heated sources and lines (Col.5, lines 36 – 44). It would have been obvious to one of ordinary skill in the art to utilize the liquid delivery system and

method of Versteeg et al. to introduce the alcohol-based liquid precursor of SEL (i.e., to introduce the precursor as a liquid into the inlet of the reaction chamber) with the reasonable expectation of (1) success, as the precursors of SEL are alcohols (i.e., organic liquids), and Versteeg et al. teach that any liquid organic precursor solution can be used in their liquid delivery system and that the system can be utilized in a microwave plasma enhanced deposition processes (i.e., such as the one of SEL), and (2) obtaining the benefits of using the aforementioned liquid delivery system, such as its simplicity, economic nature, and avoidance of cumbersome mass flow controllers, carrier gases, and heated sources and lines. Robson et al. teach that, in the process of depositing diamond from precursors such as ethanol, methanol, and isopropanol, the precursors are generally gaseous or vaporize to a gaseous form upon introduction into the deposition chamber (Col.13, lines 15 – 26). Therefore, it would have been obvious to one of ordinary skill in the art to introduce the liquid precursors of SEL into an inlet of the reaction chamber of SEL and subsequently vaporize the precursors (i.e., as opposed to first vaporizing the precursors and then introducing the vapor, as suggested by SEL) with the reasonable expectation of (1) success, as Robson et al. teach that such as process was known in the art at the time of the applicant's invention, and (2) obtaining similar results (i.e., successfully depositing diamond from a liquid precursor, regardless of whether the liquid precursor is vaporized prior to introduction into an inlet of a deposition chamber or after introduction into the inlet). Regarding the limitations that (1) the reaction chamber be in a "non-magnetic microwave field

plasma system" as required by Claim 21, and (2) the process (i.e., the promoting diamond growth) be carried out at a pressure in the range from about 20 to 80 Torr as required by Claims 1 and 21, the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. teaches these limitations. Specifically, SEL teaches that a diamond film according to their invention can be formed by using a microwave plasma CVD system that does not use a magnetic field (Figure 1 and paragraphs [0019] – [0022]). SEL teaches that this system has an advantage, namely that the equipment is very simple and cheap because no magnetic field is used (paragraph [0019]). Therefore, it would have been obvious to one of ordinary skill in the art to utilize a "non-magnetic microwave field plasma system" as taught by SEL in the diamond deposition process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. with the reasonable expectation of (1) success, as both SEL and Pryor teach that non-magnetic field microwave plasma systems can be successfully utilized to deposit diamond, and (2) obtaining the benefits of using a non-magnetic field system as opposed to a system that uses a magnetic field, such as the ability to use equipment that is very simple and cheap, as taught by SEL. SEL does not explicitly teach the applicant's claimed pressure range of about 20 to 80 Torr. However, as set forth immediately above, it would have been obvious to one of ordinary skill in the art to utilize a "non-magnetic microwave field plasma system" to deposit the diamond of SEL. Pryor teaches that, in the art of depositing diamond in a microwave plasma enhanced CVD process without using a magnetic field (i.e., a process analogous to that of SEL), pressures in the range of 20 to 60

Torr are preferred (Col.9, lines 3 – 20 and 44 – 47). Therefore, it would have been obvious to one of ordinary skill in the art to utilize a pressure in the range of about 20 to 60 Torr (i.e., pressures within the applicant's claimed range) in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. with the reasonable expectation of successfully and advantageously using a pressure taught in the art to be preferred in a microwave plasma enhanced CVD process that does not use a magnetic field, such as the process taught by one embodiment of SEL.

18. The combination of SEL, Pryor, and either Versteeg et al. or Robson et al. also teaches all the limitations of independent Claims 13 and 25 as set forth above in paragraph 17 and below. Specifically and regarding Claims 13 and 25, please note that SEL teaches that the CVD of diamond is "plasma enhanced" (Abstract and paragraph [0011]), the apparatus includes an inlet "2", a "disassociation zone" (i.e., the area in which the plasma of SEL is formed), a deposition zone (i.e., the zone in which the substrate is located), and an outlet "5" (Figures 1 and 3, and paragraphs [0011] and [0019]), and the vaporized precursor is flowed through the disassociation zone and through the outlet (Figures 1 and 3, Examples 1 – 3, and reference numbers "2" and "5"). The combination of SEL, Pryor, and either Versteeg et al. or Robson et al. does not explicitly teach that the plasma produced in the process (i.e., in the disassociation zone) contains OH, H, O, and carbon containing radicals. However, the aforementioned combination of references teaches all of the applicant's claimed method steps, including the mixed methanol precursor, the processing conditions (i.e., temperature, pressure, microwave energy excitation),

and the deposition of a diamond film from the plasma. Therefore, since the combination of references teaches the same precursors subjected to the same processing conditions to achieve the same end result (i.e., to deposit a diamond film) as that claimed and disclosed by the applicant, the process suggested by the prior art would have inherently produced the radical species claimed by the applicant. Regarding the pressure and "non-magnetic field" limitations, please see paragraph 17 above.

19. The combination of SEL, Pryor, and either Versteeg et al. or Robson et al. also teaches all the limitations of Claims 3, 5 – 7, 9 – 12, 14 – 19, 22 – 24, and 26 – 30 as set forth above in paragraphs 17 and 18 and below, including a method wherein / further comprising:

- Claims 3 and 15 – The methanol is present in the liquid precursor in an amount between about 0.5 wt.% and about 99.5 wt.% of the liquid precursor. While this limitation is not explicitly taught by the combination of references above, the examiner notes that the applicant's claimed range of methanol weight percentages is broad enough to encompass essentially all methanol weight percentages in a mixed liquid precursor composition. Therefore, absent any showing of criticality or unexpected results, it would have been obvious to one of ordinary skill in the art to utilize a methanol weight percentage in the applicant's claimed range with the reasonable expectation of success and obtaining similar results (i.e., successfully utilizing a mixed methanol precursor to deposit a diamond film, regardless of the methanol concentration).

- Claims 5, 16, and 17 – The methanol is supplemented with one or more carbon and oxygen containing compounds containing carbon, hydrogen, and oxygen with an atomic ratio of carbon to oxygen greater than one (Claim 16), preferably ethanol, isopropanol, acetone, or combinations thereof (Claims 5 and 17) (see paragraphs 17 and 18 above).
- Claims 6, 7, and 18 – The subjecting a vaporized precursor step is conducted at a pressure between about 1 mtorr and 250 torr, and the deposition zone / substrate temperature is between about 200 or 300° C and 1600° C (Abstract and Example 3 of SEL).
- Claim 9 – The substrate comprises a sheet or wafer of silicon, copper, aluminum, molybdenum, or alloys thereof (Examples 1 – 3 of SEL).
- Claims 10 – 12 and 14 – The plasma is formed by, or the disassociation step comprises, using electromagnetic energy, particularly microwave energy (i.e., an electrical discharge) to form the plasma (Abstract, Figure 1, Example 3, and paragraph [0019] of SEL).
- Claims 19, 23, and 27 – The carrier gas is hydrogen (Abstract and paragraphs [0010] and [0023] of SEL).
- Claims 22 and 26 – The diamond growth rate is between about 1 and 2 micrometers per hour, the pressure is in the range of about 60 to 80 Torr, the substrate temperature is in the range of about 1000°C and 1030°C, and the microwave power is about 2 kW. Specifically, using a pressure of about 60 Torr (i.e., a value within the applicant's claimed range) would have been obvious to

one of ordinary skill in the art for the reasons set forth above in paragraph 17. Additionally, while SEL does not explicitly teach the applicant's claimed diamond growth rate, temperature, and microwave power, Pryor teaches that, in the art of depositing diamond in a microwave plasma enhanced CVD process without using a magnetic field (i.e., a process analogous to that of an embodiment of SEL), preferred substrate temperatures are in the range of about 500°C to 1100°C (Col.9, lines 12 – 15), and the microwave power level should be in the range of a few hundred watts up to about 5 kW (Col.9, lines 56 – 59). These ranges taught by Pryor encompass / overlap the applicant's claimed ranges. It would have been obvious to one of ordinary skill in the art to utilize temperature and microwave power values in the applicant's claimed range (as taught by Pryor) in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. with the reasonable expectation of successfully and advantageously using known, preferred process parameters in the non-magnetic field microwave plasma diamond deposition process of SEL. Please note that a prior art reference that discloses a range encompassing a narrower claimed range is sufficient to establish a *prima facie* case of obviousness (*In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-1383 (Fed. Cir. 2003)). Regarding the applicant's claimed diamond growth rate, Pryor teaches that the diamond growth rate in a microwave plasma CVD process can be controlled based on (1) the flow of feedstock gases and (2) the microwave power level (Col.9, lines 47 – 50 and 60 – 61). Pryor also teaches

that the diamond growth rate should be balanced so that the quality of the deposited diamond film will not suffer, which can occur at the highest growth rates (Col.9, lines 54 – 68). In other words, Pryor teaches that diamond growth rate in a CVD process is a result / effective variable that can be controlled (i.e., by controlling the flow of feedstock gases and the microwave power level) in order to balance competing factors (i.e., growth rate and film quality). Therefore, it would have been obvious to one of ordinary skill in the art to optimize the diamond growth rate as a result / effective variable in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. through routine experimentation with the reasonable expectation of (1) success, as Pryor teaches that the diamond growth rate can be controlled, and (2) advantageously balancing factors such as a high growth rate and film quality in order to obtain a diamond film at a speed and having the qualities necessary for a specific application.

- Claims 24 and 28 – The liquid precursor consists essentially of methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one. Specifically, the combination of SEL and Pryor reasonably suggests utilizing a 100% alcohol precursor mixture of only methanol and ethanol (i.e., a carbon and oxygen containing compound having a carbon to oxygen ratio greater than one) (see paragraphs 17 and 18 above).
- Claims 29 and 30 – The diamond growth rate is between about 2.1 and 2.7 micrometers per hour, the pressure is in the range of about 30 – 36 Torr, the

substrate temperature is in the range of about 720°C and 800°C, and the microwave power is about 1 kW. While SEL does not explicitly teach the applicant's claimed diamond growth rate, temperature, pressure, and microwave power, Pryor teaches that, in the art of depositing diamond in a microwave plasma enhanced CVD process without using a magnetic field (i.e., a process analogous to that of an embodiment of SEL), preferred pressures are in the range of about 20 – 60 Torr (Col.9, lines 44 – 47), preferred substrate temperatures are in the range of about 500°C to 1100°C (Col.9, lines 12 – 15), and the microwave power level should be in the range of a few hundred watts up to about 5 kW (Col.9, lines 56 – 59). These ranges taught by Pryor encompass / overlap the applicant's claimed ranges. It would have been obvious to one of ordinary skill in the art to utilize pressure, temperature, and microwave power values in the applicant's claimed range (as taught by Pryor) in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. with the reasonable expectation of successfully and advantageously using known, preferred process parameters in the non-magnetic field microwave plasma diamond deposition process of SEL. Please note that a prior art reference that discloses a range encompassing a narrower claimed range is sufficient to establish a *prima facie* case of obviousness (*In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-1383 (Fed. Cir. 2003)). Regarding the applicant's claimed diamond growth rate, Pryor teaches that the diamond growth rate in a microwave plasma CVD process can be

controlled based on (1) the flow of feedstock gases and (2) the microwave power level (Col.9, lines 47 – 50 and 60 – 61). Pryor also teaches that the diamond growth rate should be balanced so that the quality of the deposited diamond film will not suffer, which can occur at the highest growth rates (Col.9, lines 54 – 68). In other words, Pryor teaches that diamond growth rate in a CVD process is a result / effective variable that can be controlled (i.e., by controlling the flow of feedstock gases and the microwave power level) in order to balance competing factors (i.e., growth rate and film quality). Therefore, it would have been obvious to one of ordinary skill in the art to optimize the diamond growth rate as a result / effective variable in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. through routine experimentation with the reasonable expectation of (1) success, as Pryor teaches that the diamond growth rate can be controlled, and (2) advantageously balancing factors such as a high growth rate and film quality in order to obtain a diamond film at a speed and having the qualities necessary for a specific application.

20. Regarding new independent Claim 31, the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. teaches all the limitations of the claim as set forth above in paragraph 17 above, except for a method wherein the conditions in the non-magnetic field plasma system include having a microwave power in the range from about 0.9 kW to 2 kW and a substrate temperature in the range between about 750°C and 1030°C, and the diamond growth rate is between about 1 and 2.7

micrometers per hour. However, SEL does teach a substrate temperature of 750 – 850°C (i.e., a value within the applicant's claimed range) (paragraph [0020]). Additionally, while SEL does not explicitly teach the applicant's claimed diamond growth rate and microwave power, Pryor teaches that, in the art of depositing diamond in a microwave plasma enhanced CVD process without using a magnetic field (i.e., a process analogous to that of an embodiment of SEL), preferred substrate temperatures are in the range of about 500°C to 1100°C (Col.9, lines 12 – 15), and the microwave power level should be in the range of a few hundred watts up to about 5 kW, preferably 1.5 kW (i.e., a value within the applicant's claimed range) (Col.9, lines 56 – 59). These ranges and values taught by Pryor encompass / fall within the applicant's claimed ranges. It would have been obvious to one of ordinary skill in the art to utilize temperature and microwave power values in the applicant's claimed range (as taught by Pryor) in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. with the reasonable expectation of successfully and advantageously using known, preferred process parameters in the non-magnetic field microwave plasma diamond deposition process of SEL. Please note that a prior art reference that discloses a range encompassing a narrower claimed range is sufficient to establish a *prima facie* case of obviousness (*In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382-1383 (Fed. Cir. 2003)). Regarding the applicant's claimed diamond growth rate, Pryor teaches that the diamond growth rate in a microwave plasma CVD process can be controlled based on (1) the flow of feedstock gases and (2) the microwave power

level (Col.9, lines 47 – 50 and 60 – 61). Pryor also teaches that the diamond growth rate should be balanced so that the quality of the deposited diamond film will not suffer, which can occur at the highest growth rates (Col.9, lines 54 – 68). In other words, Pryor teaches that diamond growth rate in a CVD process is a result / effective variable that can be controlled (i.e., by controlling the flow of feedstock gases and the microwave power level) in order to balance competing factors (i.e., growth rate and film quality). Therefore, it would have been obvious to one of ordinary skill in the art to optimize the diamond growth rate as a result / effective variable in the process of the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. through routine experimentation with the reasonable expectation of (1) success, as Pryor teaches that the diamond growth rate can be controlled, and (2) advantageously balancing factors such as a high growth rate and film quality in order to obtain a diamond film at a speed and having the qualities necessary for a specific application.

21. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Semiconductor Energy Lab (JP 05-097583 A), referred to hereinafter as SEL, in view of Pryor (USPN 5,236,545) and either Versteeg et al. (USPN 5,451,260) or Robson et al. (USPN 5,874,014), and in further view of Glesener et al. (USPN 5,381,755).
22. The combination of SEL, Pryor, and either Versteeg et al. or Robson et al. teaches all the limitations of Claim 8 as set forth above in paragraph 17, except for a method

wherein the carbon containing compound (i.e., the precursor) includes a dopant element or moiety. However, Pryor does teach that diamond films are utilized in the fabrication of semiconductor devices (Abstract). Glesener et al. teach that doped diamond for semiconductor devices can be produced by CVD utilizing carbon-containing source gases, and that natural diamond is not useful for such electronic devices because of the inability to control the dopant level (Col.1, lines 8 – 49, and Cols.3 – 4). It is known to incorporate the dopant into one of the precursors used to deposit the diamond film (Cols.3 – 4). Therefore, it would have been obvious to one of ordinary skill in the art to incorporate a dopant into the precursor of the aforementioned combination of references with the reasonable expectation of successfully controlling the dopant level of the diamond film (e.g., a level which is taught by Glesener et al. to be an important parameter for semiconductor / electronic devices such as those disclosed in Pryor) and producing diamond films for semiconductor devices as suggested by Pryor.

Response to Arguments

23. The applicant's arguments filed on 4/7/2003 have been fully considered but are not persuasive.

24. Specifically, the applicant argues that SEL, Pryor, Versteeg et al. and Robson et al., alone or in combination, do not disclose, teach, or suggest (1) a pressure range from about 20 to 80 Torr, (2) producing diamond in a non-magnetic microwave field plasma system, and (3) the deposition conditions / diamond growth rate required by

new independent Claim 31. In response, the examiner disagrees. For further explanation, please note paragraphs 17 – 20 above in which the examiner has clearly set forth the reasons that the combination of SEL, Pryor, and either Versteeg et al. or Robson et al. meets the aforementioned limitations.

25. Regarding the applicant's arguments drawn to the drawbacks of the non-magnetic field microwave plasma diamond deposition process taught by SEL (e.g., reduced film quality), simply because the non-magnetic field embodiment taught by SEL is not preferred does not make it non-obvious. For example, one of ordinary skill in the art would be reasonably expected to balance the importance of diamond film quality against the disadvantage of having to deal with complicated and expensive magnetic field equipment when choosing which type of equipment to use (i.e., magnetic field vs. non-magnetic field).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Wesley D Markham
Examiner
Art Unit 1762

WDM
June 6, 2003

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